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ABSTRACT

A review of the antecedents of the recent interest in social network analysis makes a case for using network information in mapping professional groups as part of the program planning process. Three major streams of theory and research have converged into a broad multidisciplinary approach to viewing social structure that is termed "network analysis"--the adoption/diffusion tradition, sociometry, and anthropology. A network analyst must first make decisions about the appropriate level of analysis, relational properties, and relational content. The planner is then in a position to begin collecting network information. Three critical considerations pertain to boundary specification, network sampling, and measurement. Three common methods of collecting network information are unobtrusive measures, observational reporting, and the network survey. Collected data must be summarized and interpreted. Network information is generally analyzed in a series of stages, including development of a visual display (sociogram), personal or ego network analysis, clique analysis, and total network analysis. Appendixes include a networks interview schedule and networks questionnaire. (YLB)

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QUANTITATIVE APPROACHES TO ANALYZING THE STRUCTURE OF CONTINUING PROFESSIONAL DEVELOPMENT NETWORKS

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Continuing professional educators have traditionally utilized concepts and principles of systematic program development in designing continuing professional education programs. There are a number of conceptual models to be found in the continuing education literature that depict the programming process as a series of interrelated and overlapping phases, through which the continuing professional educator links his or her organization to the professional client group in an effort to establish directions, design procedures, implement and evaluate learning programs that will bring about professional change (Schroeder, 1980). Such conceptual adult education programming models include those of Boone, Dolan and Shearon (1971), Knowles (1970), Houle (1972), and Boyle (1981). While these various approaches have their own distinct characteristics, all share an emphasis on four key subprocesses; 1) the identification of a problem, deficit or need, 2) the development of goals and objectives for a learning activity, 3) the conduct of an educational program and 4) the evaluation of that program Boone, (1985).

Perhaps one of the most characteristic themes underlying these conceptual models of the programming process is the importance of systematic planning in bringing about an effective educational program. Planning represents a significant attempt by the continuing professional educator to establish and maintain linkages with their professional clients. These linkages lead to the collaborative identification, assessment and analysis of educational needs. Implicit in this emphasis on linkage is the requirement that continuing professional educators "do their homework" and completely understand the publics for whom a given educational program is intended. Boyle (1981) defines this process as community analysis, a process through which the continuing professional educator identifies the various interactions that exist within the professional community and between professional communities. According to Boyle;

> Analyzing the community as a system does not help clarify what directions or problems need to be focused on, nor how to proceed in planning for the community's growth and development. Rather, the system helps provide a framework for analyzing the various segments of the professional community in a much more comprehensive way than if each segment were considered alone. In any system analysis, one must be able to perceive the structure not as isolated facts and figures, but as a network of interacting social forces that have given rise to the existing situation (p.150).

Boone (1985) makes a similar argument when he identifies the study and analysis of the sociocultural environment as a critical element in the linkage process. This analysis occurs through the process of "mapping". During the mapping process, the continuing professional educator must discern the distinct pattern of

interactions that exist among members of the client group. These patterns of interaction, according to Boone, are reflected in social groups that are "bound together by common goals, lifestyles, values, beliefs, sentiments and heritages" (p.93). By understanding the relations existing within and between client groups, the program developer will be better able to interface with the leadership from the various groups. The result will be a heightened commitment to programs and a more accurate assessment of needs. Mapping allows the continuing professional educator to get the "big picture" and ultimately become more effective in bringing about planned professional change. Associated with this mapping process is the necessity of identifying informal leaders within these social groups, since these informal leaders are often the individuals who are in a position to promote cooperation and bring about professional change (Rogers and Kincaid, 1981).

While these opinion leaders may hold formal leadership positions within the client groups, this is not necessarily the case. The continuing professional educator who interfaces primarily with formal leadership and fails to consider differentiated social groups and opinion leaders, will find it more difficult to design these programs.

Several methods or tools have been developed for use in identifying opinion leadership. Key informants have been used successfully to identify opinion leaders. Self-designating opinion leadership questionnaires have also been utilized. However, these techniques have not allowed planners to simultaneously "map" the relevant publics and identify leadership. Sociometric methods have been used to identify opinion leadership by asking a sample of individuals to name those individuals they rely on for advice and information. In the past, these sociometric methods were used by continuing education specialists to identify opinion leadership, but they have not provided for a more complete analysis of the client group.

Within the last ten years there has been a great deal of writing about a new approach to analyzing social groups. This new approach goes beyond a simple reporting of who talks to whom. While similar to the sociometric approach, social network analysis represents an expanded set of analytical tools, whereby a social scientist can uncover the hidden structure in a set of patterned interactions among people. This social network perspective and the associated analytical tools, have great utility for those who work in trying to bring about planned educational change within professional groups. In the following paragraphs, a description of the social networks approach will be given.

SOCIAL NETWORKS: A CONCEPTUAL INTRODUCTION

The concept of social network has been defined in a number

of ways, but perhaps one of the most commonly cited definitions is that given by Mitchell (1969), who suggests that a social network is a "specific set of linkages among a defined set of persons, with the property that the characteristics of those linkages as a whole may be used to interpret the social behavior of the persons involved (p.2)". Social network analysis represents an emerging approach to studying the structure of social groups. Network analysis provides a unique perspective from which to view social structure (Boissevain, 1979). Proponents argue that it represents a broad intellectual approach and not simply a "bag" of methodological tools or techniques (Wellman, 1981). The approach emphasizes the tremendous impact that social structure has on an individual's freedom to act. As a research style, it focuses on peoples' social networks as a way of understanding their behavior (Fischer, 1977). It is based on the assumption that individual behavior is a function of the networks to which he or she belongs. For example, in mapping a professional community the network analyst may go beyond examining local professional organizations with spatially determined boundaries, and may focus instead on the patterns of interpersonal ties that cut across formal or prescribed boundaries. Network analysts look for interactions between individuals that exist at a much deeper level than are found in typical organizational structures. The social networks approach represents a way of cutting across formal boundaries of local professional groups and allows one to examine the total professional field in which the individual is embedded (Mitchell and Trickett, 1980).

The distinct qualities that network analysis holds are the result of a combining of several different streams of research that are familiar to continuing education professionals. Network analysis really represents a convergence of some very old and familiar research traditions that have been coupled with some more recent and sophisticated analytical tools (Laumann and Pappi, 1976).

The Adoption/Diffusion Tradition

For many years researchers have looked at the impact of one's position in the social structure on the decision to adopt innovations. This line of research has been particularly productive in providing practical knowledge that can be used in introducing new ideas and technologies into a culture. Program developers in the Cooperative Extension Service often rely on this behavioral science information in introducing new farming techniques, nutritional programs, etc. This line of inquiry has highlighted the importance of interpersonal connections in not only influencing one's decision to adopt, but also in understanding how new ideas are diffused through these connections (Rogers and Shoemaker, 1971). One's position within an overall network of relations influences the extent to which information and resources are available to the individual and determines the rate at which ideas and technologies are shared.

The adoption/diffusion research tradition has also made a mark in the professional setting. For example, Coleman, et.al. (1966) found that professionally isolated physicians were more likely to prescribe a new drug later than those physicians who maintained regular professional contact with colleagues.

Sociometry

Another very strong research tradition related to network analysis was the "sociometric approach", which developed primarily out of the pioneering efforts of Jacob Moreno (1934). Moreno developed many methodological tools used to measure variation in networks and referred to networks as "more or less permanent structures that bind individuals together into complex lines of transportation and communication (p.214)". Moreno developed the sociometric questionnaire, in which individuals were asked to identify their contacts; for example, the questionnaire might ask the respondent to identify his or her four best friends, or the three people whose judgements are considered most valuable.

Perhaps Moreno's major invention was the sociogram, a simple diagram of points (representing people) and lines (representing the connections between those people). While an effective tool for examining group structure, sociograms have been criticized as being arbitrary, since they are not defined in a precise way. Analysts can develop very different looking sociograms based on the same information (Alba, 1981). An additional criticism centered around the fact that the drawing of sociograms became very prohibitive once the size of the network grew past 50 or 60. Developing the sociogram was a very arbitrary and time consuming activity. According to Rogers and Kincaid (1981), the fundamental problem with the sociogram is that "the sociogram may be wrong. An infinite number of sociograms may be constructed from one set of network data, each of which may convey a different picture of the communication structure. There is no objective standard procedure for drawing sociograms (p.92)."

Followers of the Moreno tradition began to use matrices and matrix algebra in examining sociometric data (Festinger, 1949). Hence, the adjacency matrix was developed as a means of recording connections (1's) or non-connections (0's) between individuals. These later advances in sociometric methods became highly mathematical as matrices were manipulated to identify cliques (Festinger, 1949; Luce and Perry, 1949) or social distance (Katz, 1953). When coupled with the body of knowledge about graph theory (Harary, et. al., 1965), sociometry provided an important set of concepts that were embellished in the more recent work of the network analysts. This combination of ideas from sociometry and mathematical graph theory has led to the development of computer algorithms that provide for an analysis of a much larger and wider range of networks than was ever before possible. In many ways, network analysis is an expansion and reinterpretation of the methods developed in the sociometric research tradition.

Anthropology

A number of ideas from anthropology have had an impact on the development of social network analysis as a unique analytical perspective. During the middle 1950's, researchers began to examine the migration of individuals into urban society and the impact of that migration on the well-being of the immigrants. (e.g., Bott, 1971; Mitchell, 1969; and Boissevain, 1974). These researchers found that migration to the urban setting was a major adjustment and that interpersonal ties played a major role in facilitating that adjustment. Informal ties that spanned both time and geographic distance were identified as being very important. These ties represented the "pipelines" through which information, advice and encouragement flowed to minimize the disruption caused by displacement. Out of this research has come a great deal of information linking the structure of social networks to various outcomes such as professional productivity (e.g., Breiger, 1976), career advancement (e.g., Granovetter, 1974) and psychological well-being (e.g., Eckenrode and Gore, 1981). Much of the recent work on personal or ego networks seems to have grown out of this tradition.

These three major streams of theory and research have converged into this broad multi-disciplinary approach to viewing social structure that has most recently been termed simply "network analysis". In the following paragraphs a number of the methodological issues confronting network analysts are considered and several simple techniques used in analyzing network structure are delineated.

METHODS OF NETWORK ANALYSIS

Research Design Issues

According to Knoke and Kuklinski (1982), relationships between individuals represent the basic building blocks of network analysis. The set of persons identified in the network represent the actors or nodes. These actors in the network usually share some common characteristics or attributes; e.g., they all may be members of a professional organization such as the American Society for Training and Development (ASTD). Social network analysis lets the analyst view the relations and non-relations between network actors. It is the structure of the relations among network actors and the positions of actors that have "important behavioral, perceptual and attitudinal consequences both for the individual units and for the system as a whole (p.13).

There a are a number of research design issues that face individuals who are hoping to conduct an analysis of a professional network. Four of these are particularly important and have been described by Knoke and Kuklinski (1982). Their comments are summarized below.

Issue One: Who Will Comprise the Network ?

The analyst must have a very clear picture of who will make up the network before beginning the investigation. Will the focus be on individuals, groups, organizations, classes or communities ? A network analysis can be conducted on each of these levels. Before beginning a study, the analyst must have a clear image of who should be be included in the assessment. For example, the continuing professional educator may be interested in looking at the relationships between physicians in the local community. In such a case the sampling unit would be the individual physician. However at a higher level of analysis, the planner may want to analyze the network of relations between local physicians' groups within the six county area. In this case, the unit of analysis would be each local physician's group. This is an example of an interorganizational network.

Issue Two: What Properties of the Relationships Are of Interest?

The relationship between a dentist in city A and another in city B can be described in terms of both content and relational form. Relational form simply refers to the characteristics of the relationship that exists between the two actors. These characteristics exist independently of the content and may be classified in terms of strength, intensity, durability or the extent to which they are involved in the same types of activities. For example, the two dentists mentioned above might interact socially with the same degree of intensity and over the same time period, as they would when engaging in an exchange of professional information. The continuing professional educator must decide, a priori, what properties he or she hopes to examine in the relationship.

Issue Three: What Type of Network Connections Are To Be Identified?

Professionals engage in an exchange of information and resources for any number of reasons. For example, journal articles, advice pertaining to retirement planning and emotional support may be exchanged. These are examples of specific types of relational content. These represent analytically distinct types of exchanges between professionals. Professionals may exchange physical objects, services, information, etc. The analyst must be very clear about the types of connections he or she is interested in before examining such a network. (Burt, 1983a).

Issue Four: What Level of Analysis is of Interest?

A network study may focus on one of several distinct levels of analysis, according to Knoke and Kuklinski (1982). The personal or egocentric network is based around each individual

unit of analysis. For example, if ten practicing physicians were surveyed, there would be ten distinct egocentric networks in the analysis. Each physician could be characterized by the number, magnitude and type of relationships he or she has with those identified as network partners. An example of such a network is given in Figure 1.

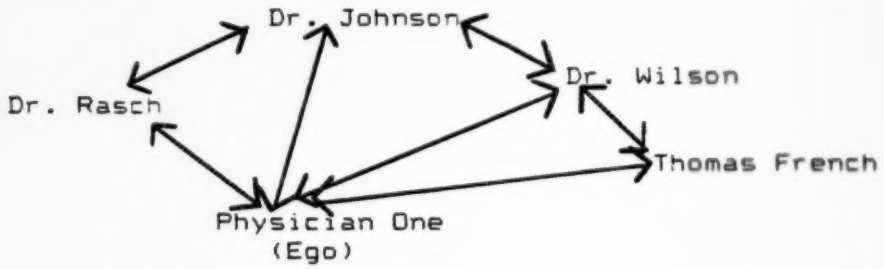

Figure 1. Personal or Ego Network of Physician One

At this level of analysis, there is one analysis for each principal actor. Such an analysis would indicate that Physician One's ego network or personal network is composed of four individuals, that the network is very dense, and that most of the linkages to others in the network were reciprocal.

A second level of interaction occurs at the dyadic level, i.e. at the level of the interaction between actor one and actor two. For example, such an analysis might focus on the relationship between two faculty members in a university, Faculty members A and B, as indicated in Figure 2.

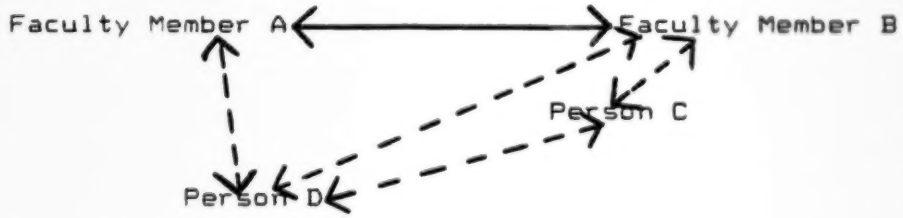

Figure 2. The Dyadic Exchange Between Faculty Members A & B

In this type of analysis, the focus is on the type of connection between A and B. A typical question raised in this type of analysis is whether there is a direct relationship between A and B, or whether the relationship exists through one or more intermediaries. In an analysis with N actors, there are $(N^2-N)/2$ possible dyadic relationships. This type of analysis allows the investigator to determine the types of attributes that might be related to the social distance or proximity between the two actors. Such an analysis might seek to determine if the closeness of ties between dyadic pairs of nurses is related to the hospital floor they work on.

A third level of network analysis focuses on triads,

although the research in this area is not extensive. A sample size of N would have N/3 triadic units of analysis. According to Knoke and Kuklinski (1982)," research on triadic ties has typically focused on the issue of transitivity (p.17)"; i.e., if nurse A contacts nurse B, and nurse B contacts nurse C, is it likely that nurses A and C are in direct contact with one another?

The fourth level of analysis, the complete network analysis, has perhaps received the greatest amount of attention in recent years. In this type of analysis, the continuing professional educator would look at the pattern of ties existing among all of the individuals in the network. An overall analysis of a network reveals such phenomena as clique formation, social isolates and highly prominent network figures. This type of analysis can reveal important information about the level of cohesion, integration or openness in the network. It is critical that the continuing professional educator consider carefully the level of analysis desired. Each level of analysis yields qualitatively different kinds of information.

Collecting Network Data

Once decisions are made about the appropriate level of analysis, relational properties and relational content, the planner is in a position to begin collecting network information. Associated with this step are three critical considerations; i.e. considerations pertaining to boundary specification, network sampling and measurement.

Boundary specification simply refers to the process of setting limits when collecting network information, when in fact there are no real network limits (Barnes, 1979). The decision about where to draw boundaries must ultimately be made based on theoretical considerations of the professional group under study (Knoke and Kuklinski, 1982). Laumann, et. al., (1983) describe two approaches to determining where appropriate boundaries should be drawn. These are termed the nominalist and realist positions. Taking a nominalist approach, the continuing professional educator would make the decision to study formally bounded groups, such as a statewide nursing association. All members of this formal group would be studied, since they represent the planner's conception of professional nurses in the state. This approach can be problematic, however, since very important professional ties or contacts may arbitrarily omitted. The result could be a faulty picture of the overall network.

A realist approach to boundary specification would include any of those professionals who are relevant to one another, regardless of formal organizational boundaries. This approach emphasizes the importance of setting boundaries according to the client's conception of who is or who is not in the group. Persons to be included in this network are selected on the basis of their mutual relevance--i.e. only those individuals who are

relevant to one another are included in the network. For example, in studying the relations among professional associations of medical personnel within a state, only those organizations that have a high degree of relevance to one another would be included. Selections for inclusion might be based on reputation (e.g., judgements as to how influential a group is) or the extent of involvement in state-wide decision making (formal position). Organizations could also be selected for inclusion after the initial data has been collected. This approach has been referred to as a "snowball sampling" and results in a network of groups, whose membership was defined by the groups, rather than some a priori conception of the planner.

The process of mapping a client group usually implies that every unit in the network is studied. This is possible when the networks of interest are small. For example, a faculty development specialist may be interested in examining the communication network within the College of Medicine. In such a case, it may be feasible to study all members of the college. However, when a professional network is so large that it is impossible to have each unit respond (i.e., the network can not respond in its entirety) the analyst may be forced to use a **network sample** to estimate the network properties. This can be particularly problematic in network analysis because relational properties are being estimated without using complete information.

One effective means of estimating network properties on the basis of a sample was developed by Granovetter (1976) and was more recently described by Erickson and Nosanchuk (1983). Using this technique, the analyst draws a random sample of names from an overall list of the larger network. The names selected in the sample are then compiled into a list. This list is then given to everyone selected, along with a question (or questions) about the relationship with the persons listed. The process is as outlined in Figure 3.

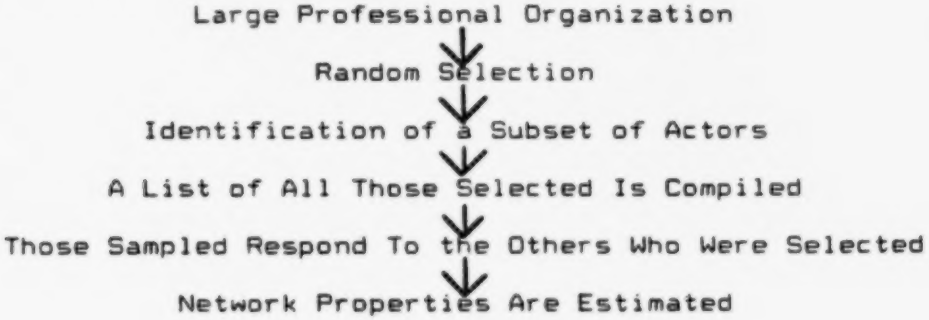
Large Professional Organization
Random Selection
Identification of a Subset of Actors
A List of All Those Selected Is Compiled
Those Sampled Respond To the Others Who Were Selected
Network Properties Are Estimated

Figure 3. The Network Sampling Process

Using this method, the density of the ties between individuals in the sample is an unbiased estimator of the density

existing in the total network. However, as Knoke and Kuklinski (1982) point out, there are a number of problems associated with this approach. In particular, very little can be said about personal or ego networks based on such a sampling approach, since an incomplete list of response choices are given. If one hopes to obtain an accurate picture of ego networks, then the actors' choices must not be constrained by pre-determined lists.

Several methods can be used to obtain information from professionals about their network connections. The type of data collection procedure that is utilized will be dependent on the decisions made earlier in the research design phase. Several common methods have been described elsewhere by Knoke and Kuklinski (1982). Their explanations will be summarized below.

Observational techniques can be utilized to collect network information if the network of interest is very small. The information obtained from this approach may be expected to have a high degree of validity. Since the continuing educator is observing the process of interaction, he or she is in a position to interpret the interactions in a way that is much more meaningful than would be the case if the information was collected through a survey. Many continuing professional educators unconsciously use this technique in an informal way as they interface with client groups. However, the ability to get the "big picture" is limited by this approach. It is simply too difficult and labor intensive to map larger interacting groups using the observational approach. The sensitive continuing professional educator should make use of this technique when meeting with clients and keep observational notes of were interactions are taking place. For example, in attending a professional meeting, the continuing professional educator might find it useful to study the regular interactions among members of the professional group. Another disadvantage of using the technique, however, is that the observer can end up being very obtrusive (Rogers and Kincaid, 1981). One will certainly stand out if detected recording interaction patterns at a large meeting.

Unobtrusive measurement represents another source of information pertaining to networks that may be used by continuing professional educators. (Rogers and Kincaid, 1981). There are a number of such methods in existence. For example records of telephone calls could be used to look for linkages between professional groups, appointment calendars could be used to examine connections, or clients could be asked to keep logs listing those to whom they send and receive information although one might argue that this last suggestion is certainly not unobtrusive. Often such unobtrusive information serves as a useful supplement to information gathered from other sources. Two different sources of information about interpersonal ties are archival data and key informants (Burt, 1983b; Burt, 1983c). Archival records have also been used to examine the overlap of membership on organizational boards of directors, etc.

The continuing professional educator might map a large professional network by examining the number of common members between pairs of organizations. A great overlap represents a strong tie between organizations. This approach is taken from the large body of research that has accumulated on interlocking corporate directorates and could be very useful in mapping a large professional community.

The most common method used to collect network information is the network survey (Knoke and Kuklinski, 1982). Usually only a few questions are asked in these surveys, but when analyzed appropriately, the responses can yield a great deal of network information that can be of value to the program planner. The manner in which and analyst decides to ask his or her network questions is extremely important and must be based upon the research design considerations discussed earlier. According to McCallister and Fisher (1983):

> The techniques used to elicit names determine what kinds of people are included in the network membership, and therefore, the operational definition of network used in the subsequent analysis (p.77)

A network question designed for community physicians might take on the following form:

Thinking back over the past six months, with whom in the three county area have you discussed the issue of AIDS ?

In asking this question to physicians, several considerations that were mentioned earlier in this paper have been addressed. First, the concern is with developing a picture of the total network, although data will be obtained that can be used to examine alter/ego or dyadic communication. Second, the question is only asking respondents to indicate whether or not a relationship exists. No information is sought related to the durability or strength of the relationship. Third, the relational content has been defined. Specifically, the respondent is asked only to report interactions that have occurred on the topic of AIDS. Fourth, a boundary has been specified. The respondents are asked to limit their listings to other people in the three county area. A time boundary has also been imposed (within the past six months). However, no limits have been placed on the types of persons that may be listed as part of the network. A physician may list a brother, a priest or another physician. It is important that all of these considerations be made in designing a network survey. There is also a danger in creating network questions that are too restrictive. For example, the previous example may be reconstituted in the following form:

With what other family practitioners in Erwin have you discussed the treatment of AIDS victums over the past two weeks ?

The specification in this question may be so narrow that

no links would be reported. Hence, it would be difficult for the analyst to identify any real network. According to Rogers and Kincaid (1981), it is critical that the analyst knows how specific to be in asking network questions and that this knowledge be based on an understanding of the degree to which the topic is discussed among respondents. The key is to develop a question that is as specific as possible, without being too restrictive.

In constructing such a survey instrument, the continuing professional educator must know the extent to which the content is discussed among the client group. If he or she does not have this information (e.g. the frequency with which physicians talk about AIDS) "extensive pre-testing of the sociometric instrument is necessary in order to understand the audiences discussability of the topics studied (p.98)".

The pretest instrument should include enough questions to cover the range of possible content. The importance of using a pretest to refine the instrument should not be taken lightly, because improperly specified questions may lead to grossly distorted representations of the network.

Another consideration that must be made is whether or not to limit the number of choices a respondent can make. For example, a respondent may be asked to name the three persons that he or she interacts with the most. This technique is not used extensively today since it imposes an artificial restriction on the size of a respondent's network. If a whole network is to be surveyed, it may be useful to give each network member a list of names. He or she then responds to each person in the network. This is called the roster approach, and allows each person the opportunity to say whether he or she was connected to each individual.

Sociometric questions can either be asked orally or they can be included in a self-report questionnaire. Both techniques are frequently cited in the literature. Although more labor intensive, the interview format may have the advantage of allowing the analyst to interpret responses and perhaps keep the respondent on task. Fatigue may not occur as quickly using the interview approach. This will lead to a more valid description of the network.

A final consideration in developing the sociometric questionnaire involves determining what other relevant questions to ask about a relationship. Often analysts find it useful to know more about a set of relationships than simply "who talks to whom". The interest may be in determining how long a relationship has been in existence, how often a contact occurs, or whether or not a relationship is reciprocal. In these instances, the analyst can get a more detailed picture of the pattern of interactions between respondents by soliciting this type of information. Questions may be asked about attributes of either the respondent

or those mentioned as network partners. Individual attributes can then be examined in relation to network information. If person A selects individuals B,C and D, it might be very useful to ask A additional questions (deemed important for a specific investigation) about the characteristics of B,C and D. Relevant questions might include, How Old Is Each of Those Individuals Listed?, How Many Years of Experience Do Each Of Those Listed Have? or Where Did Each Of Those Person's You Listed Obtain His or Her Highest Degree? This type of information may be of interest to the analyst as he or she maps a particular professional group. For example, it might be informative to learn that individual or personal networks are composed of professionals who attended the same institutions of higher education.

Three common methods of collecting network information have been described. Those methods included 1) unobtrusive measures, 2) observational reporting and 3) the network survey. Rogers and Kincaid (1981) suggest that it is good practice to use more than one method of data collection when mapping a client group, since each of the three techniques has complimentary strengths. Examples of two network surveys are included in Appendix A and Appendix B. Appendix A is an example of the interview format while Appendix B is an example of the questionnaire format.

Once network information has been collected, it must be summarized and interpreted. This will be the focus of the next section of the paper.

Analyzing Network Data

To illustrate many of the possible ways of representing social networks information, a portion of a data set involving network relations among a subset of nursing faculty members will be used. The data were collected as part of an effort to design a more effective faculty development program in a School of Nursing.

Questionnaires were distributed to all faculty members in the School of Nursing. The questionnaire was similar in format to that found in Appendix B. Respondents were asked to name colleagues from whom they sought advice pertaining to their professional roles as teachers and researchers.

The Sociogram

Network information is generally analyzed in a series of stages, with one of the first stages being the development of a visual display. Traditionally the sociogram has served as a useful means of getting a general picture of the overall network structure before beginning a more complex analysis. A sociogram for the example just given is shown in Figure 4.

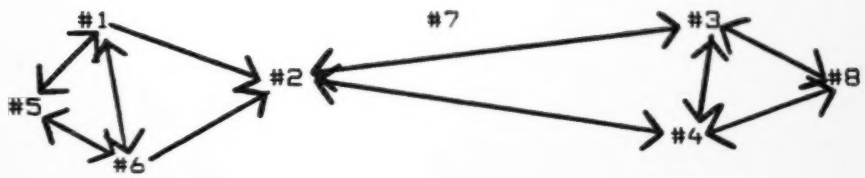

Figure 4. Sociogram of A Teaching Exchange Network In A School of Nursing

In the sociogram, the units of analysis (in this case, individual faculty members) are represented as **points** and the relationships are expressed as **lines**. This diagram of the eight person network is very easy to understand and allows the analyst to obtain an initial look at the network structure. However, the points and lines could be drawn in any number of different configurations when based on a simple description of "who talks to whom". This represents the problem in using the sociogram. The initial inspection does give an indication of the central role played by #2 in the network and the lack of direct contact between the #3/#4/#8 triad and the #1/#5/#6 triad. This collection of points and lines is termed a **graph**. There are N^2-N possible connections in such a graph (in this example, 64-8 possible connections). If all possible connections are present, the network is said to be complete.

In terms of graph theory, any two points are considered **adjacent** if there is a line that connects them. If a point is not adjacent to any other point, it is considered unconnected. There are three possible types of relationships that can exist in the preliminary map of the professional group; 1) **symmetric ties** are represented by double headed arrows and indicate a two-way exchange 2) **asymmetric ties** represent one way exchanges and 3) **null relations**, or no direct relationship. In the nursing example, there are eight symmetric, two asymmetric and eighteen null relationships between the $(N^2-N)/2$ pairs of points.

Knoke and Kuklinski (1982) describe another very important feature of these directed graphs (or sociograms) as **path distances**, where a path exists between two points if a sequence of lines connects them through other points. A path between #1 and #3 would involve the line sequence #1-#2-#3 or it might involve the #1-#6-#5-#2-#3 sequence. The sequence must be traced back only along arrows going in the proper direction. A path distance is simply the shortest sequence of lines that must be followed in linking to points in a network. In the previous example, the #1-#2-#3 connection would represent the smallest path distance between #1 and #3. These path distances are useful in calculating very sophisticated measures of overall network structure. Many of these techniques require the use of computer technology and are beyond the scope of this paper.

Within the sociogram or graph the analyst can begin to identify subgroups or **cliques**. Rogers and Kincaid (1981) define cliques as subgroups whose members tend to interact with one another more than they interact with others in the network. For example, #1,#6,#5 appear to represent a clique.

There are also a number of very important individual roles that become apparent as the analyst inspects the initial sociogram. These individual roles have associated with them distinctively different communication behaviors (Rogers and Agarwala-Rogers, 1976). There are six major types of individual roles. These roles are summarized below.

1. **Gatekeeper**
The gatekeeper is an individual who is located in a network position where he or she can control the flow of information and resources. A gatekeeper may serve to screen information and resources before they are passed along to other members of the network. The continuing professional educator should identify the gatekeepers when mapping the network, since those individuals play such a crucial role in assuring that information is disseminated to all parts of the professional network. Groups or cliques can also be considered as gatekeepers. For example, an executive committee may screen communications directed toward network members.

2. **Liaison**
A liaison is sometimes referred to as a linking pin since a person in this position typically connects two or more cliques in a network, without him or herself being a part of either clique. Rogers and Agarwala-Rogers (1976) refer to liaisons as "the cement that holds the structural bricks of an organization [network] together(p.135)". In a professional network they transfer messages and resources between different cliques and provide a sense of overall identity to the network. The professional development specialist must be critically aware of the liaison within a client network and use these persons as essential points of interface.

3. **Bridge**
A bridging role is very similar to the liaison role, in function. The primary distinction between the two roles stems from the fact that the bridge maintains a position in one of the cliques being linked, whereas the liaison is not a member of either of the two groups being linked.

4. **Opinion Leader**
Opinion leaders are those people who are able to influence the attitudes and behaviors of others in the network (Rogers and Agarwala-Rogers, 1976). These individuals tend to have greater access to information and resources due to a greater number of connections external to the network. Generally, opinion leaders exhibit a high degree of conformity to professional norms and have a high level of access to the network membership. These

people are very important for those involved in designing educational programs, since they are in a position to provide significant informational input when designing a program and are able to encourage client participation. On a sociogram, these individuals typically have a number of asymmetric ties leading to them from other members of the network. These persons may be considered those who carry a great deal of network power.

5. Cosmopolitans
An individual in a cosmopolitan role has a high degree of contact with individuals or groups outside of the professional network. Often these are the individuals who are most visible to continuing professional educators. The individuals are important in providing information from the outside that will bring about change in the network, yet do not necessarily carry the power to influence others. While the continuing professional educator should certainly work with these individuals, they may not represent the best sources of information about client needs. Their ability to create change is also limited when compared to the liaison.

6. Isolate
Isolates are those individuals who remain unconnected to other network members. These individuals may not have a high level understanding of sentiments or needs in the professional group and do not possess the ability to influence others. They are not in a position to work with the continuing professional educator in designing professional programs.

In the faculty development network mentioned previously, several of these network roles were identified. Person #2 was clearly an opinion leader due to the many asymmetric connections that were directed toward that person. Person #7 was isolated from the rest of the nursing faculty members. Person #2 also appeared to play a liaison role, by serving as a "pipeline" through which information and resources moved from one clique to the other. Since these nurses' responses were limited to intra-network connections due to the way the sociometric question was worded, no information was available on cosmopolitanism.

As this inspection of the graph or sociogram suggests, there are a number different roles evident within the nursing faculty development network. However to obtain a more complete understanding of this group of professionals, the analyst must also seek answers to such questions as; Why do nurses #1, #5 and #6 appear to cluster together?, Why is person #7 isolated? or How cohesive is this group?.

To answer these types of questions, networks analysts have developed a set of techniques that can be used to measure the structural properties of networks. Some of these techniques are very simple, while others require complex computer technology. Generally, these structural properties of networks can be broken down into three distinct levels of analysis; 1) personal or ego

network analysis 2) clique analysis or 3) total network analysis. Each level of analysis answers a different set of questions. All of these levels should be considered by the continuing professional educator as he or she maps the client group. The complimentary pieces of information obtained from each of these levels of analysis, coupled with the visual display from the sociogram, will give the educator a more complete understanding of the client group.

Analyzing Personal or Ego Networks

One very important consideration in examining structural contraints on individual professionals is is to identify the personal networks they maintain. These individually centered networks have been termed personal communities (Wellman, 1982) or ego networks (Burt, 1982). The personal network for individual A, consists of all the persons with whom A has a direct relationship and the relationships between all those who make up A's network. Consider the faculty development example considered previously. If nurse #2 had been asked to name those persons she contacted about problems related to teaching, she might have depicted a network that looks like the Figure 4.

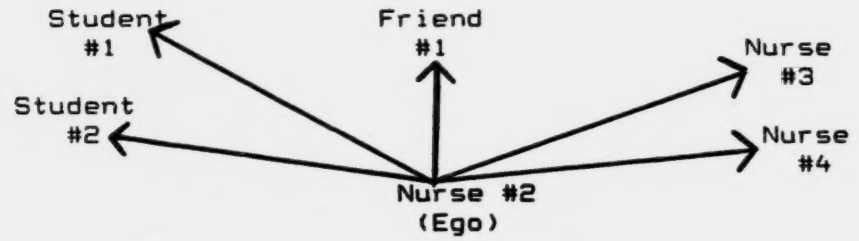

Figure 4. Personal or Egocentric Network of Nurse #2 (Ego)

The personal network of nurse #2 is made up of two students, a personal friend and two faculty colleagues. [Note: In the actual study this network was not identified because the nurses were asked to restrict their choices to faculty colleagues within the School of Nursing] Several useful properties can be calculated from an examination of the personal network.

1. **Range:** According to Boissevain (1974) the most important structural property of a person's ego network is the size or range of the network. Range simply refers to the number of individuals named as members of the network. In the example, nurse #2 had a personal network range of five. In examining the entire School of Nursing, one might discover that the average range of faculty members' ego networks was two. An interesting question would be whether interest in participation is related to network range or is interest simply a personal attribute.

2. **Density:** Network density refers to the extent to which members of ego's personal network connect with one another, independently of ego. Rogers and Kincaid (1981) refer to this property as

integration. Density is expressed as a proportion of the total possible connections that could exist (Shulman, 1976). For example, if nurse #2 from the previous example had been asked to indicate what connections existed between members of her network, her response might have looked like Figure 5.

Figure 5. Interconnections Between Members of Nurse #2's Ego Network

In any network there are N(N-1) possible asymmetric connections. In the example from Figure 5, there would be (5)(5-1) or 20 possible connections. Six connections existed (6/20) or 30%. The density of the network would be .30. It might be useful for the continuing educator to understand, on the average, how "closely knit" the ego networks of one's clients are. This is a very important property since the degree of ego network density or integration has been shown to be negatively related to the potential for information exchange (Rogers and Kincaid, 1981). This follows the strength of weak ties arguement of Granovetter (1973 & 1982).

3. **Reciprocity:** Reciprocity is simply an estimate of the extent to which the connections in an ego network are reciprocal. This may be expressed as a percentage of the possible number of reciprocal connections. In the example, 2/5 or 40% of the contacts were reciprocal.

4. **Intensity** or **Frequency:** The strength of a connection is expressed in terms of intensity. In the example, nurse #2 may have been asked to estimate the number of contacts per month she had with each of her network members. An average would give an estimate of the number of contacts regarding teaching that occur on a monthly basis (Mitchell and Trickett, 1980).

5. **Durability:** Durability may be expressed by asking ego to estimate the length of time he or she has been involved in a given relationship with others in the network (Shulman, 1976). Again, an average value could be calculated for an ego network.

6. **Homogeneity/Diversity:** Homogeneity refers to the extent to which members of an ego network share a common attribute. For example, there may be an interest in finding out the role that students play in the professional development of faculty members. In the nursing example, it might be useful, from a program planning standpoint, to know that on the average, 40% of the

teaching improvement resources cited were students.

The analysis of ego networks can shed a great deal of light on some of those "why questions" mentioned previously, by looking at some of the potential impacts of structural factors on the behavior of individuals. This type of analysis could be particularly informative if coupled with information about the attributes of network members. One finding from the study of professional development networks of nursing faculty members was that those faculty members who had older colleagues as members in their restricted ego networks, were less interested in learning more about the process of research. The network perspective suggests this lack of interest may be more a function of network influence than personal attributes.

Clique Analysis

A clique represents a subset of individuals within an overall network who interact with one another more frequently than they interact with others in the network. Typically cliques or subgroups are identified through one of three different methods; 1) a visual examination of a sociogram 2) manipulation of an adjacency matrix or 3) a computerized clustering or scaling program. Regardless of the procedures used, cliques are formed on the basis of proximity or nearness of individuals. All approaches to clique detection rely on the proximity of individuals. The difference in the techniques is tied to the methods used to estimate proximity.

In the early sociometric tradition, analysts sometimes rely on a visual inspection of the sociogram to identify subgroups of individuals who appear to interact regularly. For small networks this may be an effective method. However, when the network becomes large it virtually impossible to correctly identify the patterns of relations among network members. Proximity measurement is primarily a mental process of arranging and rearranging points and lines on a graph until they "look right". The identification of cliques is a very subjective process.

Matrix manipulation and matrix multiplication represent two additional approaches for clique detection. In order to perform either of these analyses, the network information must be assembled into what is termed a binary adjacency matrix. In this matrix, those respondents who are choosing network members are listed along the left side of the matrix, while those chosen are listed along the top of the matrix. Using the previous example, one row and one column correspond to each of the eight network members. The presence or absence of connections between members is indicated by placing a (1) where a connection exists and a (0) where no connection exists. These values are entered in the appropriate cells in the adjacency matrix. The diagonal cells, representing self-connections, are left blank. The matrix is called a binary adjacency matrix because connections are scored as one and non-connections are scored as zero.

An example of the eight member (who-to-whom) adjacency matrix for the School of Nursing example is given in Figure 6.

		WHOM							
		#1	#2	#3	#4	#5	#6	#7	#8
	#1	-	1	0	0	1	1	0	0
	#2	0	-	1	1	0	0	0	0
	#3	0	1	-	1	0	0	0	1
W	#4	0	1	1	-	0	0	0	1
H	#5	1	0	0	0	-	1	0	0
O	#6	1	1	0	0	1	-	0	0
	#7	0	0	0	0	0	0	-	0
	#8	0	0	1	1	0	0	0	-

Figure 6. Binary Adjacency Matrix For The Eight Member Faculty Development Network

The adjacency matrix can be very useful because a great deal of information is summarized in a small space. By squaring the matrix the analyst can identify two-step indirect relationships (e.g., the relationship between A and B, through person C). Cubing the matrix yields three-step indirect connections, etc. These path distances (indirect linkages) between pairs of individuals can be used as input into one of several complex computer analysis systems to obtain a more precise identification of cliques. Techniques are available to identify cliques by hand based on these obtained proximities but their derivation is beyond the scope of this paper. Techniques have also been designed to manipulate the adjacency matrix by rearranging the rows and columns based on observed connections, so that individuals who are connected become closer together on the list. After a series of iterations, clusters of connections or cliques will begin to develop along the diagonal of the matrix. The analyst can revise the list until the clusters are fully defined.

Currently the most commonly used techniques for detecting cliques require the use of sophisticated computer technology. These developments have only come about in the last 10-15 years and have greatly expanded the analyst's ability to examine complex networks. A number of programs are available. The fundamental difference in these programs centers around the manner in which proximities are calculated. The end result is very similar in most cases; i.e., these distances are used to examine the degree of closeness, and result in the identification or subgroups. The nursing data presented in Fugure 6 was analyzed using a cluster analysis program from the Statistical Analysis System (SAS). The following clusters were identified in the analysis based on their proximities: Cluster One contained #1, #5, #6; and Cluster Two contained #3, #4, #8.

Once cliques have been identified, either through the use of sociograms, the rearrangement of an adjacency matrix, or a computerized clustering program, measures of clique structure can be calculated in a manner similar to that used in analyzing

personal networks. The following represent some of the clique level properties that can be assessed.

1. **Clique Density:** This corresponds to the proportion of all possible connections within the clique that actually do occur, where (N)(N-1) represents the total number of contacts possible. In the example of nurses #1, #5 and #6, there were a total of six possible connections [1*5, 5*1, 1*6, 6*1, 5*6, 6*1]. All of the six connections existed. Hence the clique had a density of 100%.

2. **Clique Openness:** Openness refers to the extent to which members of a clique are linked to others, external to the clique. Such a measure would be calculated by dividing the number of connections for members of a clique that cross the network boundary by the total number of cross boundary connections that are possible. In the nursing example, there were 30 possible outside connections for clique #1, #5, #6. Two of these ties existed so the degree of openness was 2/30 or 7%. (Rogers and Kincaid, 1981). Openness should represent a very significant group phenomena that should be considered by program planners.

3. **Clique Connectedness:** This represents the extent to which cliques in the overall network are connected to one another. It is calculated as the number of linkages between a clique and other cliques in the network, divided by all such connections that are possible.

Total Network Analysis

A number of different measures can be calculated which identify the structural properties of the overall network. Many of these are similar to measures calculated at the personal network and clique level. Network density and network openness are examples of measures similar to those used at the lower levels of analysis. Network cohesion (Knoke and Luklinski, 1982) is a concept represented by the number of mutual choices in a binary adjacency matrix, divided by the maximum possible number of choices. A number of indices of structural position can also be calculated for individuals within the total network. Several of the more common indices are given below.

1. **Indegree:** Indegree refers to the proportion or number of relations received by individual A from other members in the network. For example, nurse #2 could have received a total of seven nominations in the nursing network. She actually received four. Thus, her indegree was 4/7 or 57%. Indegree may also be considered as an estimate of one's prestige or the extent to which he or she is sought out by others. Indegree may be established quickly by figuring column totals in the binary adjacency matrix.

2. **Outdegree:** Summing the number of choices made by individual A gives a measure of outdegree; i.e., the extent to which an individual seeks out others.

3. **Centrality:** Centrality simply refers to the extent of a person's involvement in the total number of relations that exist in the network. An individual can have a high degree of centrality and a very low level of prestige, if most of the relations are outgoing.

4. **Prestige:** Prestigious individuals are actively sought out by other members of the network. Indegree represents one measure of prestige, although a number of additonal measures have been established to take into account direct and indirect connections or connections from other network members who are themselves prestigious. Knoke and Burt (1982) have identified five different ways of calculating prestige (along with five methods of calculating centrality).

The decision to utilize one measure over another is very complex and should be based on a very careful analysis of the types of questions the continuing educator is trying to answer. Only a few measures have been cited here. Many more are available. In fact one of the major problems facing network analysts (and potential analysts) is the terminological confusion introduced through the development of so many different techniques for analyzing the structure of networks.

SUMMARY

The purpose of this paper has been to review the antecedents of the recent interest in social network analysis. A case has been made for using network information in mapping professional groups as part of the program planning process.

Social network analysis rests on the assumption that group structure exerts a tremendous influence on individual behavior and that understanding that structure will allow planners to explain and predict behavior. Personal attributes are neither the sole determinant of perceived needs of professionals, nor are they the only force behind participation in educational programs. A deeper understanding of these structural characteristics will enable planners to more successfully identify those who play out various individual roles in professional networks, understand the properties underlying clique formation and suggest points for articulation with the overall network.

This complex mapping process will lead to more effective communication with clients. The result will be a more enlightened approach to needs identification, more responsive programs, greater client participation and higher levels of learner satisfaction with continuing professional education programs.

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SURVEY OF SOCIAL NETWORKS (SSN)

INTERVIEWER: During the next few minutes I would like to gain an understanding of the people who are important to you along a number of different dimensions. I will be reading descriptions to you of the way in which individuals are often important to us. After I read each description, I will ask you to give me the names of those people who currently fill that description. These people might be friends, fellow students, family members, teachers, doctors, ministers, or any other people you might know.

I will only ask you to give me the names of people you actually know and persons you have actually communicated with during the past <u>two months</u> (stress this point). It is possible, then, that you will not get a chance to name someone that for some reason or another was not in contact with you during that past two months.

If you have any questions about the descriptions after I read each one, please ask me and I will try to make it clearer.

NAME_____

Section I. Network Connections

Part A. Personal Advice Network

When situations have come up, over the past two months, and you needed some personal advice, who are the persons that actually gave you important personal advice? Give me either full names, first names, initials or nicknames.

	Name	Relationship	Sex	Race	Reciprocity
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Probe: Is there anyone else who has offered you personal advice over this time period?

Interconnections:

DO NOT WRITE IN THIS SPACE

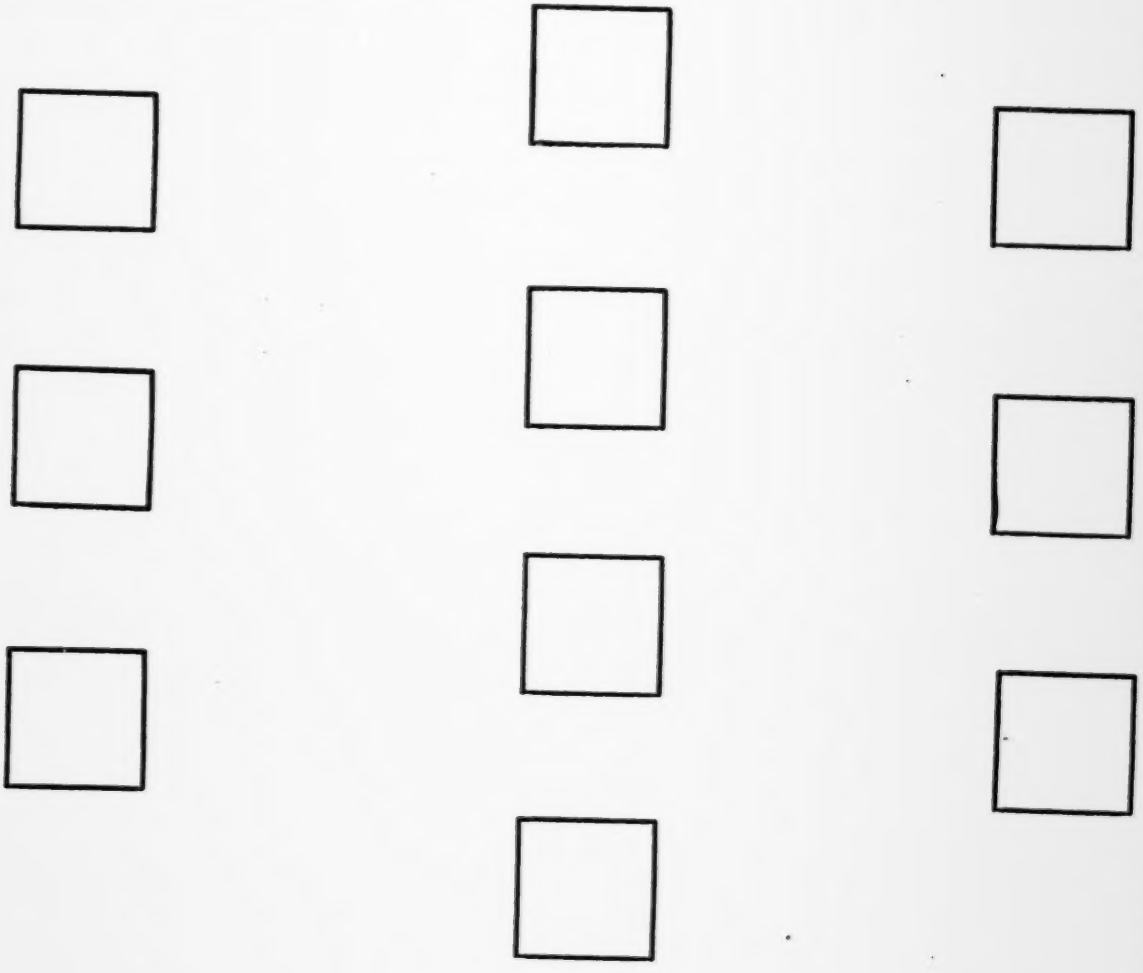
Network Range =

Network Density =

Network Reciprocity =

NAME _____

NETWORK TYPE _____



Section II. Characteristics of Networks

Part A. Personal Characteristics of Network Members

Now I would like to get some information about the people you have just listed. For each person on the list, could you tell me:

1. What is this person's relation to you? For family members specify the exact relationship (mother, father, sister, brother, grandmother, etc.). For professional people, also specify the exact profession (teacher, minister, doctor, counselor, etc.). If a friend, indicate whether a fellow student/friend or non-student friend.

2. What is the person's sex.

3. What is the person's race?

4. Did you also offer the same type of support to this person? (INTERVIEWER INDICATE "YES" OR "NO" IN RECIPROCITY COLUMN.)

Part B. Interconnectedness of the Networks

Now I would like to determine the extent to which members of each of your identified networks serve as sources of support for each other. One each of the sheets, I have listed the names of the individuals you named as providing a particular type of support. For each of these networks, please draw in the type of interconnections that you believe each of the network members give one another, by drawing a line from one box to another. Please be accurate and try to draw in all the existing interconnections among network members. If two persons are not connected, do not draw a line between them.

APPENDIX B: NETWORKS QUESTIONNAIRE

College of Medicine Survey of Learning Support Networks

Part I. Personal Contact Inventory

A. *Instructions: Think back over the last six months and try to recall any times you have had questions about or problems relating to your role of teacher in the Quillen-Dishner College of Medicine. Please list the names of individuals to whom you have turned for advice or in seeking information that helped you improve your performance as a teacher. (These persons may include faculty members, residents, students, family, colleagues from other institutions, personal friends, etc. -- as long as they helped you develop in the role of teacher.) In addition, please estimate the number of such contacts you have had per month with each individual, the type of relationship you have with each individual (family member, friend, resident, colleague, spouse, faculty colleague, etc.). Finally, indicate whether the relationship is reciprocal; i.e. does the individual also seek similar kinds of information from you?*

Name	Contacts per Month	Relationship	Is the relationship reciprocal?
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

B. *Instructions: Now think back over the last six months and try to recall times when you have had questions about or problems relating to your research in your role as a researcher in the Quillen-Dishner College of Medicine. Please list the names of individuals to whom you have turned for advice or in seeking information that helped you improve your performance as a researcher. These persons may include anyone who has assisted you in improving your research skills, whether faculty members, friends, residents, out-of-state leaders in your specialty, etc. In addition, please estimate the number of such contacts you have had per month with each individual, the type of relationship you have with each individual (family member, spouse, out-of-state faculty colleague, resident, etc.). Finally, indicate whether the relationship is reciprocal; i.e. does the individual also seek similar kinds of information from you?*

Name	Contacts per Month	Relationship	Is the relationship reciprocal?
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			

C. *Instructions: Estimate the number of contacts per month that you have with university faculty outside of the College of Medicine, pertaining to your role as a teacher.*

_____contacts/month

D. *Instructions: Estimate the number of contacts per month that you have with university faculty outside of the College of Medicine, pertaining to your role as researcher.*

Part II. Biographical Sketch

A. *Instructions: This portion of the survey is designed to elicit information about your background and professional characteristics. Please respond to each of the following questions.*

1. What was your date of birth? _____/___/____
   Month Day Year

2. What is the highest degree that you hold? (Circle One)

   B.A./B.S./B.S.N. M.A./M.S./M.S.N. M.D. Ph.D./Ed.D.

3. How many years since you received your highest degree? _____years

4. How long have you been employed as a faculty member in the field of higher education? _____years

5. How long have you been employed as a faculty member at East Tennessee State University? _____years

6. What is your current academic rank? (Circle One)

Instructor	Clinical Instructor	Assistant Professor	Associate Professor	Professor

7. Do you have academic tenure? (Circle One)

Yes No

8. Do you have an administrative assignment? (Circle One)

Yes No

If yes, please list the title_____

9. If you have an administrative assignment, what proportion of your total professional time is spent on that assignment? _____%

10. How many articles have you had published in professional journals over the last two years? _____

11. How many papers have you presented at professional meetings over the last two years? _____

12. How many out-of-state professional meetings have you attended in the last two years? _____

13. In how many published books have you been a contributing author over the past two years? _____

14. How many monographs, technical reports, etc. have you published over the past two years? _____

15. On how many University committees have you served over the past two years? _____

16. What percentage of your professional time is devoted to:

Teaching_____% Service_____% Research_____%

Part III. Importance of Information Sources

A. *Instructions: Please assign a value to each of the following in terms of its importance to you as a source of information about new techniques or methods of teaching, using the following scale: VI=Very Important, I=Important, SI=Slightly Important, U=Unimportant.*

1.	Professional meetings	VI	I	SI	U
2.	Continuing education/faculty development courses	VI	I	SI	U
3.	Professional journals	VI	I	SI	U

4.	Discussion with educational specialists/consultants	VI	I	SI	U
5.	Discussion with colleagues	VI	I	SI	U
6.	Books	VI	I	SI	U

B. *Instructions: Please assign a value to each of the following in terms of its importance to you as a source of information about new techniques or methods of conducting research, using the following scale: VI=Very Important, I=Important, SI=Slightly Important, U=Unimportant.*

1.	Professional meetings	VI	I	SI	U
2.	Continuing education/faculty development courses	VI	I	SI	U
3.	Professional journals	VI	I	SI	U
4.	Discussion with research specialists/consultants	VI	I	SI	U
5.	Discussion with colleagues	VI	I	SI	U
6.	Books	VI	I	SI	U

Part IV. Faculty Development Interests

For items 1-6, please use the following scale:

1=not at all important
2=slightly important
3=moderately important
4=quite important
5=very important

A. *Please indicate how important each of the following is to you as a motivator for improving your teaching.*

1.	Formal recognition (awards and honors)	1	2	3	4	5
2.	Informal recognition from peers or students	1	2	3	4	5
3.	Promotion	1	2	3	4	5
4.	Increased pay	1	2	3	4	5
5.	Tenure	1	2	3	4	5
6.	Personal satisfaction	1	2	3	4	5

For items 7-12, please use the following scale:

1=not at all important
2=slightly important
3=moderately important
4=quite important
5=very important

B. *Instructions: Please indicate how important each of the following is to you as a motivator for improving your research skills?*

7.	Formal recognition (awards and honors)	1	2	3	4	5
8.	Informal recognition from peers or students	1	2	3	4	5
9.	Promotion	1	2	3	4	5
10.	Increased pay	1	2	3	4	5
11.	Tenure	1	2	3	4	5
12.	Personal satisfaction	1	2	3	4	5

C. *Instructions: Please respond to each of the following items by selecting the most appropriate response.*

13. Have you ever audited or taken for credit, any formally established university or college course(s) on education/teaching? (If no, then go to question 14.)

Yes_____ No_____
(Check One)

14. Please list the number of semester hours and number of courses you have taken in each of the following areas related to education/teaching.

Area	Estimated Number of Hours	Estimated Number of Courses
Educational Psychology	_____	_____
Instructional Design	_____	_____
Teaching Methods	_____	_____
Evaluation/Testing/Measurement	_____	_____
Sociology of Education	_____	_____
Other (please specify) _____	_____	_____

_____

15. Have you ever audited or taken for credit any formally established university or college course(s) in the area of statistics/research methodology? (If no, then go to question 16.)

Yes_____ No_____
(Check One)

16. Please list the number of semester hours and number of courses that you have taken in each of the following areas related to the research process:

Area	Estimated Semester Hours	Estimated Number of Courses
Descriptive Statistics	_____	_____
Inferential Statistics	_____	_____
Research Design	_____	_____
Computer	_____	_____
Measurement	_____	_____
Multivariate Statistics	_____	_____
Other_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

17. During the past 6 months have you told anyone about a new teaching technique or procedure? Yes or No
(Circle One)

18. Compared with your colleagues, are you a) more or b) less likely to be asked for advice about new teaching practices? _____ (Select a or b)

19. Thinking back to your last discussion about some new teaching practice, a) were you asked for your opinion of the new practice or b) did you ask someone else? _____ (Select a or b)

20. When you and your colleagues discuss new ideas about teaching, what part do you play? a) Mainly listen or b) Try to convince them of your ideas? _____
(Select a or b)

21. Which of these happens more often, a) you tell colleagues about some new teaching method or b) they tell you about a new teaching method? _____ (Select a or b)

22. Do you have the feeling that you are generally regarded by your colleagues as a good source of information about new teaching methods? Yes or No
(Circle One)

23. During the past 6 months have you told anyone about a new research technique or procedure? Yes or No
(Circle One)

24. Compared with your colleagues, are you a) more or b) less likely to be asked for advice about new research practices? _____ (Select a or b)

25. Thinking back to your last discussion about some new research procedure: a) were you asked for your opinion of the new practice or b) did you ask someone else? _____ (Select a or b)

26. When you and your colleagues discuss new ideas about research, what part do you play? a) mainly listen or b) try to convince them of your ideas? _____
(Select a or b)

27. Which of these happens more often, a) you tell colleagues about some new research method or b) they tell you about a new research method? _____ (Select a or b)

28. Do you have the feeling that you are generally regarded by your colleagues as a good source of information about new research methods? Yes or No
(Circle One)

Thank you for participating in this survey!